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ABSTRACT

The report details a Manitoba (Canada) project to prepare public school teachers so that they can assist their students in developing essential technological literacy skills. More specifically, the project's objective was to develop and pilot a preservice teacher education component designed to prepare French immersion teachers to incorporate these skills across regular school subjects. Subjects were 16 fourth-year student teachers in the French immersion teacher education program at the University of Manitoba. In a series of workshops, the teachers developed their own technological literacy and then applied this knowledge in curriculum development projects that they piloted with students. The report begins with a description of the project, its objectives, and methodology and then offers a review of relevant literature on technological literacy in the schools and principles of instructional design. The teacher preparation model is then outlined. The subsequent two sections, presented in French, present the project's results and the results of a survey of participating teachers. (MSE)

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ED 418 594

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PREPARING FRENCH IMMERSION TEACHERS TO INFUSE TECHNOLOGICAL LITERACY ACROSS SCHOOL CURRICULA

Final Report No. 1

Project funded

by

Manitoba Education & Training

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On Official Languages in Education

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PROJECT DESCRIPTION

Project Title

Development of a Teacher Education Program Component for Preparing French immersion teachers to Infuse Technological Literacy Across School Curricula.

Overall Objectives

This project addressed a skills-gap in technological literacy that prevents young Manitobans to enter the workforce and to make a smooth school-to-work transition. While 420,000 young Canadians are unemployed, there are approximately 600,000 jobs that are not filled because employers cannot find employees with adequate skills (Human Resources development Canada, 1994). Sound technological literacy skills, will allow young Manitobans to make wise career and educational choices in high-demand technical occupations. Additionally, as technologically literate citizens they can make informed decisions regarding the impact of technological innovations on the environment and society in general.

The primary objective of this project was to address the critical need for preparing public school teachers to assist their students in developing the essential technological literacy skills. More specifically, the purpose of this project was to develop a teacher education program component designed to prepare French immersion teachers to infuse critical technological literacy skills across regular school subjects. Although the primary focus of this project is on the preservice of French immersion teachers, the proposed model could be adapted to both the preservice and inservice of classroom teachers in general.

Description of Project

Dramatic changes in world economies, coupled with rapid technological and sociotechnical changes have altered job content and skill requirements at the workplace. These changes have resulted in a growing interest in technological literacy. According to the Prosperity Secretariat (1992) technological literacy is quickly becoming essential for all Canadians in order to cope with the impact of technology at the workplace and in their daily lives. The Secretariat further indicates that: " in spite of the fact that technology impacts virtually every aspect of our modern society and its effects increase on a daily basis, Canadians are largely oblivious to it." There is a general agreement among education and business leaders regarding the urgent need for the public school systems to help students develop the essential technological literacy skills. The Prosperity Secretariat argues that technological literacy should not be a separate subject, but an integrated part to the overall curriculum.

The call requiring public school teachers to integrate technological literacy across subject matter, presupposes that these teachers are themselves technologically literate and that they can develop effective educational interventions to teach these skills. However, the Prosperity Secretariat notes that most school teachers have had no experience with technology and are, at best, uncomfortable with it and that we must assist teachers to develop their knowledge and comfort in this area. Our own teacher education program at the University of Manitoba has not been responsive to this need and we have not yet implemented any specific learning experiences to help our student teachers to meet this

community expectation. This project was designed to address this important need. More specifically, the objectives of this project were to design, develop, implement a teacher education program to prepare French immersion teachers to infuse critical technological literacy skills across school curricula.

Methods

The target population for this project consisted of an intact class of forth year student teachers (N=16) enrolled in the French immersion program at the Faculty of Education, University of Manitoba. The project objectives were accomplished using a two-prong approach. The major focus of the first prong was to assist student teachers to develop their knowledge and comfort in technological literacy through a series of workshops. The focus of the second prong was to assist these student teachers to infuse critical technological literacy skills in the teaching of regular school subjects using a project method. Students had to design a project for integrating technological literacy across content areas and they were required to test their project with a representative target population. Specific project activities are also outlined under Project Responsibility Structure.

Project Responsibility Structure

1. Review of literature and research to build a conceptual framework that will provide the necessary guiding theoretical orientation.
2. Study of exemplary programs to identify effective practices with promising potentials.
3. Consultation with experts, researchers, teachers and teacher education students to gather input for conceptualizing the proposed project.

4. Consultation with business and industry leaders to clarify their expectations and to identify internship sites for teacher education students.

5. Design and development of learning experiences based on the cognitive apprenticeship model to help student teachers to analyse regular school subjects in order to identify opportunities for infusing technological literacy in teaching these subjects.

6 Design and development of a learning experience to help student teachers to design and develop lessons and teaching materials for infusing technological literacy across school curriculums.

7. Implementation of a pilot project involving 20 U of M student teachers for testing the proposed project.

8. Evaluation of the effectiveness of the proposed project.

9. Development of project deliverables. Project deliverable in the form of a final report will include a description of the proposed learning experience model designed to help student teachers of French as a Second Language to infuse technological literacy across school subjects.

Deliverables

Project deliverable are in the form of three final reports. Report No.1, includes: the project description, literature review, teacher preparation program and the program evaluation. Report No. 2 is presented in the format of a directory of enterprises interested in providing internship experiences in technological literacy to student teachers. Report No. 3 includes a framework for integrating technological literacy across school

curriculum and a compendium of activities developed by participating students teachers for technology integration. Finding of this project have already been disseminated at the national conference of Association canadienne des professeurs d'immersion (1996) and through a formal publication in the Canadian Vocational Journal (1997).

REVIEW OF THE LITERATURE

Technological Literacy

Technological literacy is the understanding of the technological evolution and innovation in order to apply tools, equipment, ideas, processes, and materials to satisfy human needs (Pucel, 1992b). Technological literacy also includes the ability to use technology, the ability to understand the issues raised by use of technology, and the appreciation for the significance of technology (Dyrenfurth & Kozak, 1991). Technological literacy is an elusive concept of the late twentieth century. Elusive because even the experts seem to have difficulty to arrive at a concensual definition (Dyrenfurth & Kozak, 1991). The divergent paths in defining technological literacy travel between those who perceive technological literacy as knowledge alone and those who characterize it as an application of knowledge (Foster & McAlister, 1989). Dyrenfurth (1991) feels this lack of consensus reflects how diverse a field technological literacy has become, plus the fact that it is a fairly recent area of study. The misconception that technological literacy is analogous with technical literacy, computer literacy, or applied science further confuses the issue (Pucel, 1992b). Technological literacy is the umbrella under which these three groupings exist.

Technical literacy comprises the acquisition of skills and strategies required to use high concept density material during training or performance of the skill (Wright, 1992). A person may be technically literate in a particular area, but may actually be technologically illiterate in the larger scope. "Narrow vocational training in one state of technology will not enable a person to read manuals that explain new developments in the same technology", (Hirsch, 1987, p. 11).

Computer literacy is technical literacy, with the skills and materials being limited to computers. While computer literacy is certainly an important section of technological literacy, computer literacy does not equate to technological literacy (Dyrenfurth, 1991). Applied science is when a person may apply the principles of science to a practical situation. Science's role is one of understanding, while technology's role is doing, making, and implementing (Pucel, 1992b). Science and technology are closely entwined, with science providing the explanation of how something works, but technology demands an understanding of how to create technical solutions to make it work (Pucel, 1992 b).

Technological literacy begins with cultural literacy (Hirsch, 1987). Cultural literacy is defined as, "...the basic information needed to thrive in the modern world", (Hirsch, 1987, p.xii). Cultural literacy is related to language, providing meaning to communication through the use of vocabulary, in association with common cultural events and activities (Hirsch, 1987). Technological literacy has become a subsection of cultural literacy as advancing technology and the demands for fast, complex communication become a part of everyday domestic and commercial life.

Significance

It is important for Canadians to become technologically literate for social and technical reasons (Wright, 1993). From a social viewpoint, economics and politics are interwoven throughout a person's professional and personal life, reflecting in the culture of a nation. Technically, there is a need to examine the competence in utilizing technological literacy in education, business and industry (Wright, 1993). Therefore, technological illiteracy will affect our communities and our country in many ways.

DeVore (1991) identified four critical influences imposed on society by citizens who are technologically illiterate. A discussion of each of these influences follows.

An increasing drain on the resources of society by citizens unable to function effectively or contribute in a meaningful and productive way to their society. The costs of retraining the existing workforce and those entering the workforce due to deficit in the basic skills needed for the workplace are climbing (Barnes & Erekson, 1991). A basic skill requirement for the twenty-first century will be technological literacy, therefore citizens who are educated in this area will reduce the costs of training as well as being provided with greater employment opportunities (Scarborough, 1991; Stevens, 1991).

Loss of competitive economic potential by businesses and industries unable to obtain employees capable of functioning effectively in the highly complex, ever-changing, bio-technological environments. The U.S. Department of Labor (1991) stated that as the composition of the workforce continues to change, greater depth and breadth of training for employees will be necessary (Daggett, 1991). Part of this greater depth and breadth will include jobs that require citizens to be technologically literate. Business and industry will either have to spend more money on training technologically illiterate people, or will have to recruit employees from other countries. In today's workplace, the employee who is technologically literate will have greater control over political, economic, and personal influences of the work environment than the employee who is not (Barnes & Erekson, 1991).

Lessening of the level of security of nations and communities during times of emergency, when citizens who should be able to contribute were unable to do so because

of their lack of knowledge and know-how in technologies. The military uses technological hardware and software to establish the offensive and defensive capabilities of a nation. In time of crisis, the military needs to be able to draw upon a pool of citizens with basic technological literacy skills in order to supplement the military personnel already specifically trained (Barnes & Erekson, 1991).

The disenfranchisement economically, as well as politically, of citizens from participating effectively in the governance and management of their communities and countries because of the increasing technological component of society. As a greater percentage of society becomes technologically literate, this knowledge will allow the voting members to participate in more informed decision making, in theory leading to greater democracy (Pucel, 1992a; Welter, 1992; Zoller, 1991). Government creates policies and provides information about technology. This understanding can provide power for those people who can control this information (Barnes & Erekson, 1991).

Pervasiveness

How pervasive is technological literacy? Aside from the unemployment statistics and employers rating technological literacy as a desired skill in employees, few studies could be found that provided statistics on technological literacy. One study randomly selected 250 people from a telephone directory to address their technological literacy skills. Respondents were asked to rate their understanding of three terms which the authors felt represented a broad range of technological literacy, and also to supply a written definition for each term in their own words. The terms nuclear power, automation and genetic engineering were selected for this study. Approximately 70% of the respondents felt they had a good self understanding of the

terminology, while only an average of 37% could demonstrate a workable definition of these topics (Welty, 1992). This study concluded that the popular news media appeared to be the most common vehicle from which the greatest number of people received and interpreted information about the more controversial technologies (Welty, 1992). Therefore, it is important that schools take an active role in the promotion of technological literacy (Todd, 1991).

Schools and technological literacy

It is important that all people in society become technologically literate. Students need to possess greater technological literacy skills in order to enter and remain competitive in the workforce (Hansen and Froelich, 1994, Pucel, 1992b). Technology education helps students to better understand and adjust to changes in their lives caused by new developments in technology (Braukman, 1993). Technology education will empower individuals by giving them a means of eliciting greater control over their environments (DeVore, 1991). Students need to be made aware of the social and cultural implications of technological literacy. Not only upon their own lifestyle, but how technology literacy may infringe upon other societies (Pucel, 1992a).

Technological literacy in the schools should be concerned with improving students' understanding of how technological systems are integral parts of social systems, and that they cannot be fully separated from the political, cultural and economic frameworks which shape them. The goal is have students appreciate the value of technology within the context of its limitation in society. Students need to view themselves as achieving roles and responsibilities that will help shape public policy in relation to technological literacy.

Hansen and Froelich (1994) identify two main reasons why schools should be teaching technological literacy. Schools should help students to become effective, productive and

adaptive citizens therefore students need to become comfortable enough with technology to use it and not be overwhelmed or subsumed by it. Secondly, integrating technological literacy across the curriculum allows a greater opportunity for contextualization to occur. There is a greater need in the schools to contextualize knowledge or apply knowledge to everyday problems (Hansen & Froelich, 1994). Therefore, the school must implement more seriously the integration of technological education in their classes (Pucel, 1992b).

To be technologically literate, a student must not only know technology, but also be able to 'do' technology (Wright, 1993, Pucel, 1992b). 'Doing' technology includes using all the senses as well as a degree of intuition. Visual, verbal, and practical experiences, combined with a students' life experiences will work together to aid in the acquisition of technological literacy (Pucel, 1992a).

Visual experiences allow students to see the effects of technology without necessarily understanding the principles behind it (Pucel, 1992a). For example, students can see that wood floats, without understanding the principles of buoyancy. The students may then tie several logs together to form a raft, and eventually design their own floating contraption (Pucel, 1992a).

Verbally, the vocabulary base for technological literacy should begin with words that support what children see in their everyday lives and extend to abstract concepts and terms as the student matures (Wright, 1993). At the elementary level, this would enable children a better understanding of technology and how it effects their daily lives. Some sources for technological literacy at the elementary level are television, radio, constructed housing, automobiles, trains, airplanes, computers, telephones, busses, manufactured goods, food production, clothes, bicycles, heat, electricity, and common objects found in a dentist's and doctor's office (Wright, 1993).

A technologically literate vocabulary base at the secondary level would include abstract concepts and terms (Wright, 1993). Since technology involves having a practical understanding, students are expected to have a working knowledge of this technological vocabulary, not just a memorized definition of the words. This working knowledge evolves through visual, verbal and practical experiences.

Practical experiences surround things people do in their everyday lives. For example, the natives knew that brewing bark from the willow tree, and then drinking it, would relieve headaches and fever. It wasn't until years later that scientists understood the chemical properties found in this remedy (Pucel, 1992a). Practical experiences enable the student to examine how technology works, and provide opportunities to develop problem solving skills, closely related to technology.

Students' acquisition of technological literacy demands that teachers themselves are technologically literate. Many teachers have a very limited knowledge of technological literacy, or have not allowed it to exist in the learning environment (Fawson & Smellie, 1990). Teachers that do implement technology are divided amongst those that just talk about technology, while others spend time engaging their students in using technology (Todd, 1991). For students to become fully technologically literate, students must actively engage in the pursuit of making, doing, and implementing technology (Pucel, 1992b).

Cognitive Apprenticeship

Cognitive apprenticeship is an instructional paradigm that arose out of cognitive, pedagogical and vocational theories (Collins et al, 1991). The aim of cognitive apprenticeship is

to develop a theoretical framework for learning by examining how master craftspersons teach their apprentices the knowledge and skills they need to be successful in their trade. This theoretical framework is then applied to cognitive teaching (Collins et al, 1991).

Cognitive apprenticeship differs from traditional teaching in that the thinking process is made visible (Collins et al, 1991). Often, in traditional teaching, only the products of thinking are observed. A concept may be demonstrated, and a student may successfully demonstrate it back, but this does not establish if that student clearly understands the problem. In cognitive apprenticeship, the teacher and the student deliberately think aloud the cognitive processes (Collins et al, 1991).

This method of converging speech and practical activity is support by Vgostsky who claims that in children this convergence is a significant moment in the course of intellectual development (Berk, 1994). This convergence of speech and practical activity leads to higher cognitive processes and allows children think in ways that has meaning in their culture (Berk, 1994). Articulation and reflection, methods with promote the convergence of speech and practical activity, combine with modeling, coaching, scaffolding and exploration to establish a system ensuring the student has a full grasp of the concepts.

The dimensions of content, sequencing, and sociology combine with methods to create the framework of cognitive apprenticeship. Content provides an outline when deciding 'what' to teach, while sequencing establishes in what order knowledge will be acquired. Methods refer to how the information is being taught, while sociology searches for ways to adapt the learning environment to apply knowledge to realistic problems in various cultural setting (Collins et al,

1991). These four areas work together to allow for a positive transference of cognitive information from expert to novice, or teacher to student (Collins et al, 1991).

Cognitive apprenticeship falls under the constructivist views of learning (Ertmer & Newby, 1993). Constructivists believe that knowledge is a function of how the individual creates meaning from his/her own personal experience. Constructivists strive to provide learners with the means to create novel understanding to specific situations by assembling prior knowledge from diverse sources (Ertmer & Newby, 1993). Constructivist theory differs from behavioral and cognitive theories in that there is a portraying of metacognitive tasks in constructivist instructional design (Ertmer & Newby, 1993). Behavioral learning theories concentrate on basic motor skills and do not address the acquisition of higher level cognitive skills (Schunk, 1991, Cormier & Hagman, 1987). Cognitive theories focus on the way information is stored as the basis for transfer (Ertmer & Newby, 1993). The weakness with cognitive theories is that the learner must believe knowledge to be useful in a given situation before the information will be activated (Ertmer & Newby, 1993). Behavioral and cognitive theories are acceptable for introductory knowledge acquisition, but when ill structured problems and complex topics or environments are to be explored, constructivist theories give learners the conceptual power to solve problems or explore new concepts (Jonassen, 1991).

Principles for instructional design

Ertmer and Newby (1993) identify five principles for instructional design that facilitate learning. The following is a discussion of these five principles and how cognitive apprenticeship meets these criteria. The first principle is that *learning must be anchored in meaningful contexts*. Not only must the learning have some meaning for the student, the meaning must extend to the

real world as the student knows it. Berg and Stone in 1978, tested whether modeling or verbal instructions were better for enhancing problem solving skills, thus examining transfer. They concluded that all groups (modeling only, verbal only, and a combination) performed at a level superior to that of the control group. This led them to believe that a person's prior content knowledge, which is relevant to the skill being learned, will lead to more effective transfer. Studies done by Mayer (1975) and Egan and Greeno (1973) concluded that instructional techniques which emphasized meaningful learning were more effective for students who had gained some previous knowledge involving the skill to be learned. These students also demonstrated a broader transference of that skill (Mayer, 1975; Egan & Greeno, 1973).

Cognitive apprenticeship theory recognizes that many concepts taught in school seem divorced from what most students and adults do in their daily lives (Collins et al, 1991). Traditional teaching often presents isolated content taught out of the naturally occurring contexts (Wilson and Cole, 1991). Cognitive apprenticeship addresses the desire that learning should be anchored in meaningful contexts, through the notion of situated learning. Situated learning refers to the idea that the tasks, skills and abilities students learn in a classroom should reflect the way they are used in the world (Collins, et al, 1987). This will allow the student to understand the purpose or use of the knowledge and skills they are acquiring (Collins et al, 1987).

The knowledge or prior experiences a student may bring into a learning situation is often negated in many teaching situations, especially when it comes to examining the sequence of instruction (Wilson & Cole, 1991). This neglect has shown to hinder students acquisition of further knowledge in a variety of ways (Wilson & Cole, 1991). If learning can be built upon a student's existing knowledge base, then that learning is likely to be meaningful to that student.

Cognitive apprenticeship takes this into account with the sequencing of learning (Collins et al, 1991).

The sequencing of learning needs to be structured so that it continues to be meaningful as the student encounters more complex problems (Schunk, 1991). To ensure that the significance of the learning is not lost, three principles of learning are identified. These principles are: global before local skills, increasing complexity and increasing diversity (Collins et al, 1991).

Global before local skills refers to students building a conceptual map of the 'big picture' and then focusing to the details as the students gain a greater understanding of the subject matter (Collins et al, 1991). This allows the student to realize what contribution to learning has been made when only a small portion of the task has been accomplished. It also gives the student an opportunity for self monitoring, as the student can decide what needs to be done in order to complete the task. For example, students solving an algebra problem would have the total problem presented to them. The teacher may have already done the lower level computation, as the students do not yet have the skill to successfully accomplish that task. This then frees up the students' minds to concentrate on the reasoning and problem solving strategies of the problem that require higher order thinking skills. The students may find this a very interesting problem, even through initially it would have been beyond reach without the teacher's help (Collins et al, 1991).

Sequence of instruction in most curricula is designed so that the student begins with the basic skills requiring a simplistic level of understanding. Increasing complexity refers to the building of greater level of skills as necessary in order to accomplish a task. In reading, a student

would begin with the interpretation of a straight forward text and gradually build the skill to be able to understand complex, abstract text (Collins et al, 1991).

Increasing diversity refers to the construction of a sequence of tasks for which a greater range of strategies and skills is required (Collins et al, 1991). Transferability of skills would be developed here, as students learn to apply skills to more diverse problems requiring a rich net of contextual associations. Reading may be used for pleasure, for memory (a test), or to try to find out information to accomplish another task. This one skill, reading, can be readily available for use if the student is confronted with a novel or unfamiliar problem (Collins et al, 1991).

Situated learning, which resembles the way this knowledge is used in the 'real' world, and the sequencing of learning, which includes global before local skills, increasing complexity, and increasing diversity, are dimensions of cognitive apprenticeship. These dimensions strive to make learning as meaningful as possible for the learner (Collins et al, 1991).

The second principle addressed by Ertmer and Newby is that *learners must be active*. Research has shown that active learners acquire, retain, and transfer knowledge better than passive learners (Berryman, 1991). Concepts and procedures are often learned together; new concepts allow new procedures to be constructed (Riley, Greeno, and Heller, 1982). Cognitive apprenticeship strives to create an environment where all participants are actively engaged in the acquisition of skills for expert performance (Collins et al, 1987). This allows learners to actively use knowledge, rather than passively receiving it, thereby providing further meaning to the learning situation (Collins et al, 1987).

Active participation of learners will lead to a community of practitioners that accept ownership and mutual dependence. This mutual dependence will lead to a commitment from all

in the classroom as novices and experts work together to acquire the skills needed to successfully carry out a task. The more a student invests in a situation, the more committed that student is likely to become (Collins et al, 1991).

The cognitive apprenticeship model speculates that once situated learning and a community of practice are established, intrinsic motivation is likely to follow. Students will want to perform well, not just for one's self, but for the others in the group and for the success of the task as a whole. Cognitive apprenticeship identifies cooperative learning as another way to build a community of practice (Collins et al, 1991).

Cooperative learning allows students to work together when problem solving. Cooperative problem solving is a powerful motivator for students and another way of extending learning resources. Competition, especially between cooperative groups, and concentrating on the process rather than the product, promotes problem solving skill development in many areas and provides an alternative avenue for encouraging active learning (Collins et al, 1991).

Learning needs to be visited in different ways, offering varying perspectives to the same knowledge. This third principle for instructional design may be achieved by rearranging time, contexts, and/or the purpose of learning specific knowledge. Nitsch (1977), as cited by Gick and Holyak (1987), used words in highly variable instances, such as different contexts, to examine the acquisition of novel words. Transfer was facilitated better in the high variability grouping as opposed to the control group, once initial learning was acquired. Similar studies done on block presentations of letter strings revealed that once the initial learning had taken place, and the more varied the situation presented, the more successful the transfer of learning (Reber, Kassin, Lewis, and Cantor, 1980; Elio and Anderson, 1981).

Cognitive apprenticeship visits learning in different ways by addressing domain knowledge, heuristic strategies, and control strategies through situated learning. This allows for learning in multiple contexts and exploring the different conditions in which the learning can be applied (Collins et al, 1987). These strategies teach students how to reconfigure knowledge already in their possession, or to extend the student's knowledge boundaries to new territories. The knowledge of how to learn varies from general to the more specific strategies (Collins et al, 1987).

Domain knowledge involves concepts, facts, and procedures identified within a subject matter. This knowledge is at a level of memorization and/or recall. While this type of knowledge is important, it does not supply clues to problem solving, nor does it suggest how to apply this knowledge to the task at hand. Two examples of this knowledge type would be vocabulary syntax and phonetic rules (Collins et al, 1987).

Heuristic strategies are "rule of thumb" or "tricks of the trade". These are almost intuitive strategies that the expert acquires through the practice of solving problems within the subject matter. For example, a heuristic strategy for writing is knowing that the introduction will be rewritten once an essay is completed, and therefore, the writer spends little time working with the introduction on the first draft (Collins et al, 1987).

Control strategies guide the processes required to carry out a task. As students acquire greater problem solving abilities, they can decide which route to choose in order to determine the solution. Monitoring, diagnosing, and remediating are skills the expert will have mastered. This mastery may be demonstrated in reading comprehension. If a student is to state the main point of a section of text, and discovers he is unable to do this, that student may choose to reread that

section of the text. This student has monitored his progress, diagnosed a problem, and then chosen an avenue of remediation (Collins et al, 1987).

These methods of cognitive apprenticeship allows the student the opportunity to observe, demonstrate, and acquire the expertise needed to complete metacognitive tasks by performing the task at increasingly complex levels of experience. Experts verbalizing their thought processes, thereby making their thinking visible, offer student the opportunity to present various perspectives to the same knowledge (Collins et al, 1991).

The fourth principle that facilitates learning is that *learners must be able to develop pattern recognition skills and alternate ways of representing problems*. This allows learners to extend their thinking beyond the information given. Studies involved with complex problem solving have shown that a subject's performance improves with experience and familiarization with the rules defining the task (Anzai & Simon, 1979; Kotovsky, Hayes & Simon, 1985).

The premise of cognitive apprenticeship deals with every student achieving expert performance (Collins et al, 1991). This is accomplished through the stages of modeling, coaching, scaffolding, articulation, reflection, and exploration which provides the student with both familiarization and a variety of experience to solving problems and completing tasks (Collins et al, 1991).

Modeling is when the 'expert' shows how a process unfolds and explains why it happens this way (Collins, 1988). This allows the students to develop their own conceptual model of what processes are required to accomplish the task at hand. For example, a teacher solving a math problem would not only demonstrate how he/she arrived at the solution, but he would also

verbalize what conceptual processes were happening in his/her mind to allow him/her to reach the solution (Collins, 1988). This allows the students insight into the thinking processes of the 'expert'. Modeling is a useful teaching strategy because it allows students to visualize the procedure being taught while experts work out the solution (Johnson & Thomas, 1992).

In order for modeling to be effective, the expert must focus on the interaction between the outcomes of action, the action itself, and the intuitive knowing of the action (Schon, 1982). Experts know more than what they can verbalize, therefore the experts must learn to vocalize their tacit knowledge (Schon, 1982).

Coaching is when the student is now performing the task and the teacher offers hints, reminders or feedback in order to bring the student closer to the 'expert' performance (Collins, et al, 1987). An example of this would be if the student asks a teacher how to spell the word 'receive'. The teacher may respond by asking the student to think of a mnemonic device that would aid in remembrance of the correct spelling. Coaching helps to transfer learning when the conditions for performance differ from the initial teaching situation (Joyce & Showers, 1982).

When the student begins accomplishing a task, but lacks the knowledge, skills or abilities to successfully complete the task at hand, scaffolding may be used to bridge the student from novice to expert performance (Collins et al, 1991). This help may come in the form of physical or cognitive aids, such as cue cards or suggestions. It is important at this stage that the teacher have a good grasp of the current skill level the student possesses so that the appropriate support is given. As the student's skill level increases, the teacher gradually withdraws the physical and cognitive supports. This process is known as Fading (Collins et al, 1991).

Articulation, the fourth stage, involves getting students to express their knowledge, reasoning, or problem solving processes using any method available. More common methods of articulation include having students verbalize their tasks while carrying them out or having a student serve as a critic or monitor in cooperative situations and inquiry teaching (Collins et al, 1991). Verbal interaction will enhance the learning process and deepen understanding (Ault, 1993).

When confident with the concept at hand, the student should reflect upon his or her cognitive processes with an expert, another student and or him/herself (Collins et al, 1991). This reflection allows students to assess their thought processes and see what changes they could make in order to fully understand the task. Students are encouraged to reflect on and explain the elements that are common within a task so that they can establish how to make meaning of the task based upon their own personal experiences (Collins et al, 1987). Reflection may serve as a corrective measure, and/or allow a student ways to explore problem solving with troublesome or divergent situations of practice (Schon, 1982). "Replaying" techniques are commonly used in the reflection stage. Audio and video recordings are the most common methods of replay (Collins et al, 1991).

In the final stage, exploration, students are encouraged to cultivate their own mode of problem solving. This includes the development and testing of hypotheses, as well as setting goals and figuring out how to achieve them. In order for this stage to be successful, students must learn exploration strategies as a part of their general learning. Exploration strategies include learning how to frame questions in order to solve problems (Collins et al, 1991). Schunk

suggests that teachers require extensive training to pose appropriate questions in relation to the students' level of thinking (1991).

The use of modeling, coaching, scaffolding, reflection and exploration allow for the development of pattern recognition skills as well as providing students with alternate ways of thinking. Cooperative learning strategies, and students being able to work with more than one 'expert' enhances the development of pattern recognition skills and the development of different avenues of thinking.

Finally, the *assessment of the learning should be focused on the transfer of knowledge, done in a variety of environments where the knowledge is presented in a format that differs from the initial instruction.* Trollip (1979) used computer assisted instruction to train pilots in the skills of holding patterns. The students were to artificially fly a series of holding patterns at different levels of complexity. Students were given detailed pictorial and verbal feedback on their performance. Students trained in this manner did better in their evaluation flight than those students trained using the traditional method.

In cognitive apprenticeship, assessment of learning may occur at all stages of the learning. The use of cooperative learning and competitive learning, along with the method of reflection, allows for learning to be evaluated by experts, peers, competitors, and most importantly, the student him or herself. Learning is further assessed in a variety of environments as situated learning tries to make the learning situation as realistic as possible (Collins et al, 1987).

Cognitive apprenticeship successfully includes the principles for instructional design in ways that traditional teaching often omits (Wilson & Cole, 1991). Zoller (1992) supports these differences from a classroom perspective by stating:

> *Teachers can no longer be the sole "providers" of knowledge, through mediating textbooks to students. Rather they should play guiding and colearning roles, be able to design an enquiry orientated learning environment and shift emphasis from imparting knowledge to students to developing students higher order skills.* p.88.

Table one summarizes the differences of learning between the traditional method and cognitive apprenticeship. These aspects of cognitive apprenticeship make cognitive apprenticeship worthy of further investigation as an instructional design model (Wilson & Cole, 1991).

Critique

Cognitive apprenticeship has been successfully used in the classroom to design and race a solar powered racing car, design the interior of a six room historical house, and redesign the American constitution (National Council on Vocational Education [NCVE], 1991). Students performing these activities required extensive integration of academic and vocational skills. Students were often surprised by just how much they had learned and accomplished at the end of these projects (NCVE, 1991).

Criticisms of the cognitive apprenticeship model are limited. Some authors felt that the notion of "authentic" real life situations for all learning is vague and unrealistic if applied in the most extreme sense (Wilson & Cole, 1991). In later literature, Collins (1991) redefined "authentic" real life learning as making the learning situation as real as possible given the resources on hand. This led to a greater focus on problem solving skills and presented more realistic goals (Wilson & Cole, 1991).

Several practitioners of cognitive apprenticeship felt coaching would not be completely successful unless it was done on a one to one basis. Due to constraints of scheduling, staffing, and finances, many studies showed the resources were not available for this to happen unless computer simulation was involved (Johnson & McDonough Fishbach, 1992; Wilson & Cole, 1991; Prestine & Legrand, 1991; Thorndburg, 1991; Neale, Smith, & Johnson, 1990).

TABLE ONE. INSTRUCTIONAL DESIGN DIFFERENCES BETWEEN COGNITIVE APPRENTICESHIP AND TRADITIONAL TEACHINGS.

COGNITIVE APPRENTICESHIP	TRADITIONAL TEACHING
1. Thinking is made visible (Collins et al, 1991).	1. Only the end products of thinking are usually observed (Collins et al, 1991).
2. Situated learning allows for the integration of skills learned within the classroom as well as showing meaning and application to the way skills are used in the world (Collins et al, 1991).	2. Many concepts in the classroom are taught in isolation of each other (Wilson and Cole, 1991) and separate from what adults and children are doing in their daily lives (Collins et al, 1991).
3. Use of reflection and articulation enable students to make meaning of the task at hand based upon their own personal experiences and prior learning (Collins et al, 1991).	3. Prior knowledge or experiences a student brings to the learning situation is often not addressed, and may hinder the learning process (Wilson and Cole, 1991).
4. All learners are active and involved in their pursuit of learning (Collins et al, 1989).	4. Learning that takes a direct delivery route e.g. lecture format, set students up to be passive receivers of information (Berryman, 1991).
5. Situated learning allows for learning to be revisited in a variety of ways, exploring different conditions and contexts that learning may be applied to (Collins et al, 1991).	5. Learning is often limited to one perspective in one context limiting transferability (Wilson and Cole, 1991). Skills often focus on concepts, facts and procedures of a subject (Berryman, 1991).
6. Problem solving abilities are improved by presenting problems in a variety of setting and offering a variety of "experts" to help solve problems (Collins et al, 1989).	6. Focus on problem solving abilities and specific methods for problem solving has been limited (Wilson and Cole, 1991, Collins et al, 1991).
7. Tacit, heuristic knowledge is taught which is important for problem solving and transferability (Collins et al, 1989).	7. Many teachings concentrate on domain or textbook taxonomies ignoring other avenues of learning (Wilson and Cole, 1991).

When examining research that has been written involving cognitive apprenticeship, it is necessary to examine three studies which support the premise for cognitive apprenticeship (Collins et al, 1987; Collins et al, 1991). These studies demonstrate various aspects of the cognitive apprenticeship model, and correlate their outcomes of teaching to the methods found in cognitive apprenticeship.

The first study, "Reciprocal teaching of comprehension-fostering and monitoring activities" by Palinscar and Brown (1984) involved the modeling and coaching of students in four strategic skills to improve reading comprehension. These skills, which were formulating questions, summarizing information, making predictions, and clarifying difficulties, were modeled by the teacher. Initially, both the teacher and the students read a paragraph silently, then the teacher would formulate questions based on the paragraph, construct a summary and make a prediction or clarification if any came to mind. Once modeled, this process was then turned over to the student who demonstrated these skills with coaching support supplied by the teacher. As the student became proficient, the teacher faded the support, and assumed the role of a monitor by providing occasional hints and feedback.

In a pilot study this method was performed initially with students who were poor readers. The comprehension scores were raised for 15% to 85% accuracy. In a subsequent study with groups of two students, and then groups of five students, scores on comprehension tests were raised significantly. When these students were retested at eight weeks, there was little decline in their scores (Collins, et al, 1987).

The second study that supported the development of cognitive apprenticeship is "Teaching of writing". In this study, by Scardamalia and Bereiter (1985), elements of cognitive

apprenticeship were used to teach the basics of writing. The authors analyzed expert writing strategies, and then created a set of prompts for each strategy designed to aid students in adopting more sophisticated writing strategies. The teacher would model how to use these prompts, and then coach the students until they were confident using these prompts by themselves. At the end of this study, significant changes were noted in the in the nature and quality of students' writings.

Scardamalia and Bereiter introduced the concepts of reflection and articulation found in cognitive apprenticeship. While Scardamalia and Bereiter called this process coinvestigation, this process of reflecting verbally on existing strategies and articulating new strategies, provided students with procedural supports to carry out writings in more expert ways (Collins et al, 1987).

The final study that aided in the formation of cognitive apprenticeship was written by Schoenfeld (1985). Schoenfeld used the methods of modeling, coaching, fading, and student reflection, and introduced heuristic strategies, control strategies, and abstracted replay, found in cognitive apprenticeship. Schoenfeld would model problem solving strategies for solving mathematical probes in a college level mathematics course. Problem solving strategies included more than just solving the problem. Finding alternative solutions, discovering easier methods to solve the problems, and how the problem may be generalized were also examined. Schoenfeld would then assign his students into groups, and provide them with carefully selected problems to solve. He would encourage students to articulate their thought processes amongst their peers and he, himself would float from group to group asking questions and ensuring that the students were monitoring their problem solving process. Schoenfeld noted a significant improvement in the students problem solving abilities.

In reviewing the studies written involving cognitive apprenticeship, there is a fair division between quantitative and qualitative research. Quantitative studies are concerned with the product, and the control design, or pre and post treatment are stressed with the results. In the qualitative studies, greater emphasis is placed on the process, examining how cognitive apprenticeship effects the learning process. These studies focus on attitudes, learning patterns and factors effecting learning outcomes. Both sets of studies serve a purpose in examining the effectiveness of cognitive apprenticeship as an instructional design.

Similarly to Schoenfeld's study, Johnson and Mcdonough Fischback (1992) examined mathematics at the community college level. Two instructors were trained in cognitive apprenticeship and then they each taught two technical math courses. One course was taught traditionally, and the other one using cognitive apprenticeship. Students wrote pre and post test representing math skills, problem solving ability and student attitudes towards mathematics.

Results from this study were not significant, but the students in the cognitive apprenticeship classes scored slightly better than the control group on a problem solving exam and the final exam. On a standardized exam, results of the cognitive apprenticeship group were slightly lower, but not significantly. Students in the cognitive apprenticeship group displayed a lower level of math anxiety in response to a survey on their attitudes towards math.

The authors suggest that teachers need training in coaching and mentioning, that the technical knowledge of mathematics teacher should be increased, and students need to spend more time in lab sessions. Johnson and Mcdonough Fischbach (1992) felt cognitive apprenticeship should be explored further, especially in other science and technology classes.

Neale, Smith and Johnson (1990), developed a demonstration unit on how to implement a two week conceptual change section in the science curriculum. This unit was taught during a four week summer institute to eight kindergarten to grade three teachers using cognitive apprenticeship.

The researchers developed a 'configuration' checklist where they identified 31 features of conceptual change. Teachers were videotaped teaching before, during and after the summer institute, and then the videotaped was viewed for evidence of conceptual change features listed on the checklist. The results showed that teachers exhibited a high conceptual change, and 1 year later continued to use the new strategies.

The researchers discovered that teachers need better developed content knowledge, and lacked in theory courses with practical components. Courses with more developed content knowledge and practical components will allow teachers to construct subject matter knowledge in relation to lesson structure. Cognitive apprenticeship is a good paradigm that will allow this to happen (Neale et al, 1990).

Cognitive apprenticeship has been investigated for its application with children that are academically at-risk. Thornburg (1991), gathered fifty-eight grade seven students at risk of academic failure in social studies. Twenty-four students from the general population were randomly selected to be the control group. Only three of this group of twenty-four students were identified as at-risk The teachers of the fifty-eight students were each given 20 hours of training in cognitive apprenticeship and then over a seven month period, cognitive apprenticeship was used as the instructional paradigm in the classroom.

Initially, student scores on written arguments and essays were significantly higher compared to the random sampling of general students. At the year end, no significant differences among the marks were noted. While this research indicates cognitive apprenticeship may have many possibilities for at-risk students, it is important to note if a mismatch exists between cognitive apprenticeship and a student's previous learning experience (Thornburg, 1991).

Roth and Bowen (1995) investigated the culture, practices and resources in a grade eight open-inquiry science classroom using cognitive apprenticeship. The purpose of this study was to learn how students learn in an open inquiry environment in which the classroom in structure is guided by cognitive apprenticeship.

Sixty-five grade eight students participated in this study during the third term of the academic year. Data was gained through videotapes, audiotapes, field notes and journals. In this cognitive apprenticeship environment, Roth and Bowen reported that students participated in a greater amount of collaborative work, used more mediating devices and demonstrated an increase in practical competence then what they felt would happen in a traditional classroom.

Akin to Roth and Bowen's study, Jarvela (1994) examined the socioemotional processes of learning interaction during classroom teaching. The learning interaction was organized according to the principles of cognitive apprenticeship. The purpose of this study was to promote the mediation of modern technological thinking and problem solving skills for twenty-two French male seventh graders.

Students that were identified as task orientated become even more so in the cognitive apprenticeship environment. The methods of cognitive apprenticeship worked well between this group of students and the teachers. However, students identified as non-task orientated, appeared

to have negative self-cognitions, ego defensive or social dependence type coping strategies that had arisen because of cognitive apprenticeship (Jarvela, 1994).

In a single subject case study, a university supervisor who instructs teacher interns during their introductory courses in methods and teaching, and supervises the introductory teaching block was observed. This supervisor is looked upon by colleagues and students as a model teacher. When investigating this supervisor's teaching patterns, the researchers discovered that this teacher closely follows many aspects of cognitive apprenticeship, especially in the domains of methods and content. The researchers observed the supervisor's interactions with her students, and correlated them with cognitive apprenticeship, even though the teacher herself has never heard of cognitive apprenticeship. The assumption of this article that the university supervisor is an exemplary teacher because of her teaching style (Kagan & Waren, 1992).

Most of the studies neither validate or invalidate cognitive apprenticeship (Collins, personal communication, 1995; Johnson & McDonough Fishbach, 1992). Cognitive apprenticeship appears to have an impact on students' attitudes, and the students showed an improvement in the integration of academic, vocational, and interpersonal skills (Berryman, 1991; NCVE, 1991; Thronburg, 1991). Many studies concluded that cognitive apprenticeship improves the application of the metacognitive skill taught (Wilson & Cole, 1991). It was observed that cognitive apprenticeship does not work well for all students, and teachers must be sensitive to individual learning styles (Jarvela, 1994; Thornburg, 1991). All the studies indicated that cognitive apprenticeship is plausible and as effective as traditional teaching. However, more research needs to be completed before this conclusion can be ascertained.

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A Teacher Preparation Model Designed to Assist Elementary Teachers to Infuse Technological Literacy Across School Curricula.

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A Teacher Preparation Model Designed to Assist Elementary School Teachers to Infuse Technological Literacy Across School Curricula.

In a modern, democratic society, people must be knowledgeable about technology and science in order to be competent decision makers and informed consumers. Schools must equip students with technological knowledge to make these decisions, and must prepare them for their potential roles as scientists, engineers, technologists, politicians, and business leaders who will be at the forefront of technological development, and competition in the global arena....Today's elementary schools have an important mission: to prepare children to handle the technological demands of life in the 21st century (Brusic & Barnes, 1992).

Background

Dramatic changes in world economies, coupled with rapid technological and sociotechnical changes have altered job content and skill requirements at the workplace. Increasingly, employers are calling for more responsive, supportive and relevant education that will facilitate the school-to-work transition of young Canadians. While workplace requirements are calling for more productive and knowledgeable employees with more sophisticated skills, it appears that an alarming proportion of young Canadians are dropping out of school before graduation or they are leaving school without the critical skills required to perform the jobs being generated by a modern, competitive and "super-symbolic" economy (Toffler & Toffler, 1995).

There are 3.7 million young people between the age of 15 and 24 in Canada; that's about 14 percent of the population. In 1993, there were approximately 420,000 young people in any given month who were unemployed and actively looking for work. That's an unemployment rate of almost 18% for those 15 to 24 years of age. In 1992, youth made up 16.6% of Unemployment Insurance (UI) recipients and received approximately $2.5 billion in benefits. Canadian youth also received more than $2 billion in social assistance in 1992. Youth currently represents 21% of all social assistance cases. Further analysis of youth unemployment data indicates that single women with children represent almost half of the youths not in school or the labour force.

Poverty among young Canadians remains a serious social problem as over half of single people under the age of 25 lived in low income circumstances in 1992. While 420,000 young Canadians are unemployed, there are approximately 600,000 jobs that are not filled because employers cannot find employees with adequate skills (Human Resources Development Canada, 1994).

This mismatch between supply and demand can partly be attributed to a skills-gap in technological literacy that prevents young Canadians to make wise career choice in high-demand technical occupations. According to the Ministry of Education of the province of British Columbia (1992), to be technologically literate means: "to be practically, intellectually, and socially capable of dealing with the complex nature of today's technology. Individuals must learn to creatively and ethically use technical processes in harmony with society and the environment" (p. 15). According to the Prosperity Secretariat (1992, a) technological literacy is quickly becoming essential for all Canadians in order to cope with the impact of technology at the workplace and in their daily lives. The Secretariat (1992, b) also stated: "our national prosperity requires ... a flexible population, capable of handling the technological and social aspect of work and life" (p.1). Polette (1991) also indicated that: "it is critical that people in a wide range of careers and occupations achieve a greater understanding of the technological world; without this understanding, it becomes less likely that they will be able to function effectively to tomorrow's society" (p.1). Similarly, Pucel (1992) argued that citizens who do not have adequate backgrounds in fundamental technology will be "techno peasants" and will be disadvantaged. This view is also supported by Warnock (1988, p. 46): "a failure to familiarize children at school with the use of technology inhibits their imaginative potential, as well as making them incompetent and virtually unemployable when they leave school" (Cited by Lewis & Gagel, 1992). The Secretariat (1992, a) argued that: " in spite of the fact that technology

impacts virtually every aspect of our modern society and its effects increase on a daily basis, Canadians are largely oblivious to it (p.4)." Gareau and Baribeau (1987) cite a recent survey conducted in Ontario that examined attitudes held by young people about technology and its impact upon their lives. The authors surveyed 44,744 people between the ages of 13-19; of those surveyed, 60% were either afraid of technology or thought technology takes away jobs. Boyer (1983) argued that schools have so far failed to help the students to acquire critical technological literacy skills:

> We must recommend that all students study technology: the history of man's use of tools, how science and technology have been joined, and the ethical and social issues technology has raised....We are frankly disappointed that none of the school[s] we visited required a study of technology. More disturbing still is the current inclination to equate technology with computers....The great urgency is not 'computer literacy' but 'technological literacy,' the need for students to see how society is being reshaped by our inventions, just as tools of earlier eras changed the course of history. (p. 304)

There is a general consensus among education and business leaders regarding the urgent need for the public school systems to help students develop the essential technological literacy skills (Pucel, 1992). In many jurisdictions, technological literacy is now considered to be a foundation skill throughout the K-12 curricula. Although many educators recognize the importance of helping public school students to develop critical technological literacy skills, the pressure for accountability in the basic literacy skills area hinders the implementation of specific technological literacy programs. In addressing that concern the Prosperity Secretariat (1992, a) argued that technological literacy should not be a separate subject, but an integrated part to the

overall curriculum: "technological aspects [should] be integrated into all grade levels and all subjects - beginning in kindergarten - and that this includes the full spectrum of technology from the very traditional to emerging high-tech" (p. 20). Furthermore, the International Technology Education Association advocated that: "the best technology education programs are integrated into the total elementary school and provide students with experiences that reinforce the curriculum" (P. 1). Pucel (1992) also suggested that: "in order for schools to accomplish the broad goal of preparing students to enter a technological society, all areas of the curriculum must cooperate while teaching their own unique content." (p. 26)

Maley, (1985 & 1986) supported the integration of technology education across school curricula. He maintained that a holistic approach to the study of technology is necessary to the total educational development of the child. Drake (1995) indicated that integration "involves a fundamental shift in beliefs about teaching and learning and a view of reality where things are interconnected and interdependent" (p.1). Advocates of the concept of integration argue: "it is through integrated curricula experiences that children begin to see learning as a related whole rather than a meaningless fragmentation of subjects and skills" (Goodman, Smith, Meredith and Goodman, 1987, P.324). Wentz and Wentz (1995) argues that the elementary grade level is more fertile ground to reap the full benefits of technology integration because teachers have self-contained classroom where many subjects are taught in a cooperative learning environment (citing Commission on Technology, p. 1). Pedras and Braukmann (1991) have identified several projects that have successfully implemented the integration of technological literacy at the elementary level and a recent study conducted by Chinien, Oaks and Boutin (1995) indicated that three Canadian provinces have so far, implemented technology education programs in the elementary school curricula.

The call requiring public school teachers to integrate technological literacy across subject matter, presupposes that these teachers can develop effective educational interventions to teach these skills. However, the Prosperity Secretariat (1992, a) notes that: " most school teachers have had no experience with technology and are, at best, uncomfortable with it and that we must assist teachers to develop their knowledge and comfort in this area" (p.12). Most teacher education programs have not been responsive to this need and have not yet implemented any specific learning experiences to help student teachers to meet this community expectation. It is noteworthy however, that a study conducted in New Jersey by Altman (1990) revealed that 90% of elementary school teachers believed that technology is an important foundation skill for young children. Additionally, 92% of these teachers indicated a preference for infusing technology across school curricula, and 80% also indicated a desire for integrating more technology education in the teaching and learning activities (cited by Wentz & Wentz, 1995). Wentz and Wentz (1995) argued: elementary teachers who have experienced technology education training will be better able to confidently train elementary students in practical problem solving skills that cover a wide variety of applications" (p. 150).

Teacher Preparation Model

The discussion which follows will outline a proposed teacher preparation model specifically designed to help elementary teachers to integrate technological literacy across curricula. This model has two prongs: (1) Cafeteria Style Learning Experience, and (2) The Cognitive Apprenticeship Training. The Cafeteria Style Learning Experience is designed to assist teachers to develop their knowledge and comfort in technology. The Cognitive Apprenticeship Training attempts to help teachers to analyze interdisciplinary content, to identify potential to teach about technological principles within these content areas, and to develop

specific teaching and learning interventions specifically designed to infuse technology across these content areas.

Cafeteria Style Learning Experience

Some contextual elements were taken into consideration in developing this teacher preparation model. The most significant being the diminishing resources with which most Canadian universities have to operate. In this context any sustainable program designed to prepare elementary teachers in technology must be implemented within the parameters of existing resources, with little or no extra resources commitment. Additionally, the wide range of skills, knowledge and attitudes encapsulated in technological literacy; and the need for cross-training to allow student teachers to explore various areas of technology according to their needs and interest was also taken into consideration in the development of this model. In light of these two constraining elements, a Cafeteria Style Learning Experience (CSLE) appeared to be a model of choice for helping teachers to develop their knowledge and comfort with technology. This model addresses both constraints by taking full advantages of university-wide resources, cyberspace resources and community-based resources through collaborative partnerships.

Figure 1 shows an example of the CSLE model. As the name suggests, the model operates on the concept of a cafeteria where the clients can navigate freely through various menus and make appropriate selection according their needs and interests.

Insert Figure 1 here

The underlying assumption is that student teachers can make informed decisions in the selection of appropriate learning experiences to fill their technological literacy skill-gap. In this model there are four base resources available to help teachers develop the critical literacy skills, namely: (1) University of Manitoba and other resources based on collaborative community partnerships, namely: (2) Business and Industry; (3) School Setting; and (4) the Red River Community College. All resources available to the institution are shown as main menus. Each main menu is divided in sub-menus that outline recommended learning experiences to be accomplished to meet specific learning objectives. For example the Business and Industry main menu includes five specific learning experiences identified as sub-menus, namely: work experience: work-shadowing; shop observation, work-based projects and work place visits.

These menus focus on existing learning experiences that can be made available to the elementary student teachers with minimum or no additional resource commitment. The program coordinator can impose some structure over the learning experiences, while at the same time allow a considerable amount of autonomy to students regarding specific learning outcomes. For example, students may be requested to select a total of ten learning experiences but having to select a least two from each main menu. This specification ensures that students will get broad exposure to various aspects of technology from a variety of sources. Following is an example of a Site Visit learning experience form the Business and Industry main menu.

LEARNING EXPERIENCE

Business & Industry/Technology & Skill Requirements

1. Conduct your site visits according to the following guidelines.

GUIDELINES FOR SITE VISITS

Type of Project: Group project, maximum 4 students.

Number of site visits to be conducted: 2; duration of each visit: one full day: 9:00 to 4:30. One visit must focus on technological innovation and the other on employers expectations and skill requirements for high school graduates.

Technological Development

Purpose: *To familiarize with latest technological development.*

1. Familiarize yourself with various technologies in current use.
2. Gather relevant information on these technologies and perform an in-depth analysis of the same.
3. Make a critical reflection regarding the implications of your experiences for teaching and learning.

Nature of visit:

Visit of facilities, observe and/or experience various technologies in action. You may also be a participant-observer.

Skill Requirements

Purpose: *To familiarize yourself with workplace requirements and employers' expectations regarding the skills requirements of high school graduates.*

1. Gather relevant information regarding work, job content and skill requirements in the changing workplace.
2. Identify critical employability skills for high school students.
3. Identify critical technological literacy skills for high school students.

4. Identify sustainable skills for high school students.

5. Identify critical basic skill requirements for high school students.

6. Identify critical work habits for high school students.

Nature of visit:

Interview a supervisor in training or human resource development; and interview of employees (recent high school graduates at least 2) and analysis of documents.

SCHEDULE OF SITE VISITS

Due date for completing site visits

1 st visit: _____
2 nd visit: _____

Criteria for site selection:

1. Site selected must include at least one large (200 employees or more) and one medium (100 employees or more).
2. The organizations selected for visitation must employ high school graduates.
3. The organizations selected for visitation must help you (1) to develop your knowledge and comfort with related technology and (2) allow you to familiarize yourself with employers' expectations of high school graduates.

Planning Requirements

1. Write a proposal identifying 2 sites you want to visit. Explain why you want to visit these sites. Describe how the site selected will help you to (1) to develop your knowledge and comfort with related technology and (2) allow you to familiarize yourself with workplace requirements and with employers' expectations of high school graduates. Submit evidence of background research conducted.

2. Submit your proposal to your program coordinator for approval by_____.

3. Contact your sites. Ascertain that you will be able to meet your objectives. Obtain written permission to conduct your site visits and submit the same to your program coordinator on or before _____ (one from each site).

Site Visit Reports

You must submit a report after each site visit. The report must be prepared according to the following guidelines.

1. Cover page; justification of site selection; name of organization; mission statement; contact person; telephone number; date of visit; organizational design; product and services. Include your proposal.
2. Analytical description of your experience with various technologies.
3. Workplace requirements and skill expectations.
4. Summary, discussions, conclusions and implications.
5. Reflection regarding changes in your belief regarding the teaching and learning of technological literacy skills.
6. Submit a letter from your contact person to confirm that you have completed your site visit (one letter from each site).

Student teachers can be requested to develop their site visit report in the format of a portfolio.

Cognitive Apprenticeship

This component of the model is designed to help teachers analyze their teaching content, to identify potential to teach about technological principles within the content area, and to develop specific teaching interventions specifically designed to infuse technology across school

subjects. Given the nature of the information processing demand and the decision making process involved in this task, the cognitive apprenticeship merge as the method of choice for teaching these complex skills to student teachers. As the name suggest cognitive apprenticeship is an instructional method modelled after the apprenticeship system where a master craftsperson transmit trade skills to indentured apprentices. Brown, Collins & Duguid, 1988 indicated: "cognitive apprenticeship methods try to uncultured students into authentic practices through authentic activity and social interaction in a way similar to that which is evidently successful in craft apprenticeship" (p. 18). This approach differs from traditional teaching in that thinking is made visible. Bednar, Cunningham, Duffy and Perry (1991) described the cognitive apprenticeship process: "he [the teacher] thinks aloud as he searches for a solution.....The class discussion afterwards focuses on the strategies that were used, the way in which the problem was represented, how various sources of information were called upon, and how errors were a natural occurrence of trying alternative representations or strategies" (p. 96). Research indicates that novice can benefit from experts' think aloud protocol in a learning situation (Thomas, 1992). The cognitive apprenticeship training rest on the assumption that : "what is in the short-term memory is available to consciousness and can therefore be verbalised.... This method also assumes that, because information stored in long-term memory is continually entering and leaving the short-term memory, the thinking aloud process can reveal some sense of the nature of what is in a person's long-term memory" (Thomas, 1992, p. 11). According to Collins, Brown & Newman (1987) the cognitive apprenticeship is comprised of six phases, namely: (1) modelling; (2) coaching; (3) scaffolding; (4) articulation; (5) reflection; and (6) exploration. Following is a brief description of each phase:

- *Modelling:* The instructor demonstrates the task performance to the student teachers while she verbalizes her thought process.

- *Coaching:* Student teachers perform task under the supervision of instructor.
- *Scaffolding:* When student teachers cannot perform a task the instructor provide bridges by performing part of that task.

- *Articulation:* Students teachers articulate their knowledge, reasoning or problem solving skills in planning instruction for integrating technology in teaching and learning activities.

- *Reflection:* Provide opportunities to student teachers to compare their own problem solving process to that of their instructor.

- *Exploration:* Provide opportunities to student teachers to solve problems on their own.

The cognitive apprenticeship has the potential to allow student teachers to benefit from the rich expert knowledge of their instructors. It has the potential to improve the effectiveness and efficiency of initiative designed to help teachers to infused technological literacy across school curricula.

To put it all together students teachers may be assign the task of designing a segment of instruction for integrating technological literacy in a specific content area. Following is an outline of such a task.

Select a segment of instruction from any content area that you will have to teach.

Analyse the content to identify potential for teaching about technology in the content area.

Develop a problem solving teaching-learning intervention specifically designed to integrate the development, enhancement or reinforcement of related technological literacy skills in the teaching of the subject matter.

Conclusion

Technological literacy is now part of basic foundation skills for all students. The great urgency is not computer literacy but the need for empowering today's youth for daily living and for the workplace of tomorrow by developing their technological capabilities. In this broad sense technological literacy or capability is defined as: "the purposeful application of knowledge, experience and resources to create products and processes that meet human needs" (curriculum corporation, p.1, 1994). There is a general consensus that technological literacy need to be integrated across school curricula. Technological literacy can be more effectively implemented at the elementary level because of the interdisciplinary nature of instruction provided in intact classroom. However, many elementary school teachers have not been adequately prepared for these challenges and opportunities. Pre-service and in-service teacher education programs should help elementary school teachers to develop their knowledge and comfort with technology as well as assisting these teachers to infuse the teaching of technology across curricula. Given the diminishing resources in teacher education, the Cafeteria Style Learning Experience and the Cognitive Apprenticeship appear to the methods of choice for helping teachers to learn about technology and to integrate technological literacy across content area.

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LE DÉVELOPPEMENT D'UNE CULTURE TECHNOLOGIQUE PAR UNE APPROCHE TRANSDISCIPLINAIRE : ÉVALUATION DU PROJET

L'OBJECTIF FIXÉ, LES MODIFICATIONS APPORTÉES ET LES RÉSULTATS OBTENUS

L'Objectif:

L'objectif principal de ce projet était de concevoir, de développer, de mettre sur pied et d'évaluer une composante, à la formation initiale des enseignants en immersion, axée sur l'intégration de la technologie par une approche transdisciplinaire. Pour atteindre cet objectif, deux étapes avaient été proposées: (1) d'amener les enseignants en formation initiale à développer un niveau de confort personnel face à la culture technologique ; et (2) de les aider à intégrer la culture technologique aux programmes scolaires, par une approche transdisciplinaire. De plus, ce projet comptait sur l'effet multiplicateur qu'auront, dans leur milieu de travail éventuel, ces enseignants initiés à une culture technologique au niveau du personnel enseignant et des élèves.

Modifications apportées au projet :

Deux variables hors de notre contrôle nous ont amenées à apporter certaines modifications au projet proposé, entre autre: (1) le montant de la subvention obtenu étant de beaucoup inférieur à la demande nous a obligé à limiter l'envergure du projet; et (2) une baisse du nombre d'étudiants inscrits en immersion au programme de formation initiale est passé de 24 à 16, réduisant ainsi notre population à 16. Parmi les objectifs proposés dans la demande de subvention que nous avons dû écourté, il y a l'étude de centres de formation exemplaires, la consultation avec les experts, chercheurs et la consultation avec le milieu des affaires et de l'industrie. Tel que mentionné dans les objectifs du projet, nous avons plutôt concentré nos efforts sur la conception, le développement et la mise sur pied d'une composante, à la formation initiale des enseignants en immersion, axée sur l'intégration de la technologie par une approche transdisciplinaire.

Les Résultats du projet:

(1) Ce projet a permis l'achat d'équipement, de matériel de support, de ressources éducatives (livres et vidéos) permettant d'offrir des cours en éducation technologique aux enseignants inscrits aux programmes de formation initiale et continue en immersion. Nous sommes à aménager un atelier de formation pour l'éducation technologique, espérant que cet atelier pourra devenir un centre d'excellence pour le Manitoba. Tous les équipements, matériel de support, et ressources éducatives ont déjà été mis à la disposition des enseignants en formation de même qu'aux enseignants dans les écoles.

(2) Une enseignante en immersion de la division scolaire de St-Vital a reçu une formation de six crédits axée sur l'intégration de la technologie par une approche transdisciplinaire dans le cadre d'un post- baccalauréat, durant les sessions d'été et d'automne 1996. Cette enseignante a pu

mettre en application, dès l'automne 96, dans ses classes de 7e et 8e année immersion, les principes appris dans ces cours de formation continue.

(3) Les phases de conception, de développement, et de mise sur pied d'une composante à la formation initiale des enseignants en immersion, axée sur l'intégration de la technologie par une approche transdisciplinaire, ont été complétés. Un groupe de 16 étudiant(e)s inscrits aux programmes de formation initiale en immersion ont pu bénéficier de cette formation.

(4) L'effet multiplicateur de ce projet commence déjà se faire sentir. L'enseignante ayant participé aux sessions de formation d'été et d'automne 1996 a déjà été un excellent agent multiplicateur:

(a) Cette enseignante a contribué à la formation initiale des 16 enseignants en immersion, axée sur l'intégration de la technologie par une approche transdisciplinaire;

(b) Cette enseignante prépare un atelier de formation continue axé sur l'intégration de la technologie par une approche transdisciplinaire, au niveau de sa division scolaire pour les enseignants de la 7e et 8e année. Cet atelier aura lieu à l'automne 1997.

(c) Cette enseignante prépare un deuxième atelier de formation continue axé sur l'intégration de la technologie par une approche transdisciplinaire, au niveau élémentaire pour tous les enseignants d'une école de sa division scolaire.

(5) La diffusion et promotion de l'orientation didactique proposée dans ce projet:

(a) Une intervention au Congrès de l'Association Canadienne des Professeurs en Immersion (ACPI) à l'automne 1996: 'Comment mieux préparer nos élèves à affronter les défis de la société hautement technologique par une approche transdisciplinaire'.

(b) La publication de l'intervention dans les actes du congrès de l'ACPI, automne 1997;

(c) Une publication dans le journal de l'Association Canadienne de la Formation Professionnelle, vol. 32 No. 3, printemps.

(d) La publication d'un recueil d'activités de la maternelle à la 9e année visant le développement d'une culture technologique par une approche transdisciplinaire.

(6) L'obtention d'une somme de $7,000.00 alloué par la faculté d'éducation de l'université du Manitoba pour l'achat d'équipement, de matériel de support et de ressources éducatives.

(7) Des demandes de subvention pour le développement et la mise sur pied d'un institut d'été, au niveau de la formation continue, axé sur l'intégration de la technologie par une approche transdisciplinaire, ont été soumis.

(8) Nous avons déjà reçu un appui financier ($1,500.00) de 'Continuing Education Division' de l'Université du Manitoba pour le développement de l'institut d'été.

(9) Nous avons aussi reçu l'appui de Alliance of Manufacturers & Exporters Canada, pour la mise sur pied de l'institut d'été. ($1,000.00).

(10) Nous avons fait une demande à L'Unesco pour être le centre univoc.

(11) Notre projet pédagogique nous a amené à développer des liens étroits avec le Groupement Européen d'Établissements de Formation pour le développement de Partenariats créé par Greta Leman. Nous sommes à travailler sur un projet visant la différenciation et l'individualisation des parcours étudiants. L'objectif de ce projet euro-canadien est de parvenir à une démultiplication par l'institutionalisation d'un réseau d'établissements euro-canadiens de parcours de formation individualisés.

ATELIERS DE FORMATION POUR LES ENSEIGNANTS ET ENSEIGNANTES EN IMMERSION FRANÇAISE: ÉVALUATION DES ATELIERS

Nous avons été très impressionnés par l'intérêt que vous avez démontré pour les ateliers consacrés à l'intégration de la culture technologique dans la salle de classe par une approche transdisciplinaire. Nous vous prions de bien vouloir prendre quelques minutes de votre temps pour compléter ce questionnaire afin de nous aider à améliorer ces ateliers à l'avenir.

Question 1

Décrivez brièvement votre perception de ce qu'est la technologie, avant et après ces ateliers en culture technologique.

Avant

Selon les réponses obtenues dans le questionnaire d'évaluation que les participants ont rempli à la fin des ateliers, on constate que la plupart d'entre eux (75 %) associaient la technologie aux ordinateurs. En fait, 42 % des répondants ne voyaient que les ordinateurs lorsqu'il était question de technologie et 33 % des répondants y voyaient également l'ordinateur mais l'associait soit aux mathématiques, à l'électronique (magnétoscope), aux machines en général ou à la création d'articles ou de biens destinés à améliorer les conditions de vie.

Les autres répondants voyaient dans la technologie soit tout ce qui a trait à l'électronique, la télévision et les médias, soit ce qui concerne la construction ou la fabrication d'objets, soit la capacité d'apprendre le fonctionnement des choses.

Après

Après l'atelier, 42 % des répondants affirment que leur vision de la technologie s'est élargie. On comprend que la technologie englobe plus que les ordinateurs, l'électronique ou la science pure, on la voit comme englobant tous les domaines touchés dans la salle de classe. Dans 58 % des cas, on comprend davantage la technologie soit comme un processus de réflexion pour la résolution de problèmes ou comme l'utilisation de la pensée créatrice pour faire face à des situations problématiques vécues. On souligne l'importance de la communication inter-individuelle comme partie intégrante du processus de résolution technologique, permettant ainsi à des non-scientifiques de participer à l'élaboration de solutions. On note également que la technologie est maintenant perçue comme une façon différente de faire, ou d'envisager la résolution de problèmes.

Question 2

Est-ce-que ces ateliers vous ont aidés à développer une attitude plus positive envers la technologie ?

Parmi les répondants, 83 % affirment que **Oui**. Parmi eux, 4 sur 10 sont heureux de constater que tous ont leur place dans le processus technologique, peu importe l'âge et la formation. On souligne ailleurs que l'on a acquis une vision plus large de la technologie, que l'on aime la résolution de problèmes, qu'il faut développer l'esprit positif des élèves, ou que l'on apprécie l'esprit multidisciplinaire des objectifs.

Un seul répondant émet une réticence à cause du caractère complexe et des frais engendrés. Un autre souligne, par contre, qu'il possédait déjà un esprit positif à ce sujet.

Question 3

Si l'occasion se présentait, aimeriez-vous éventuellement suivre un autre atelier (ou cours) en culture technologique? Quel contenu aimeriez-vous que ces ateliers couvrent ?

Tous les répondants sont favorables à l'idée de suivre un autre atelier. 42 % des répondants préféreraient des ateliers consacrés à un seul niveau d'enseignement, surtout les très jeunes ou les plus avancés au secondaire.

On recherche surtout des idées précises de projet (42 %) et des façons d'intégrer les objectifs dans une approche multidisciplinaire (33 %). Autrement, on aimerait plus de matériaux pédagogiques, comme des programmes d'ordinateurs, on veut une insistance sur les étapes du processus, sur les projets impliquant des objets communs, on veut plus de temps pour les croquis, ou on considère que c'est une bonne expérience.

Question 4

Est-ce-que ces ateliers vous ont aidés à améliorer votre connaissance de la culture technologique ?

Les répondants affirment que oui dans une proportion de 83 %. Même si généralement on se contente d'affirmer avoir amélioré sa connaissance, on apprécie avoir manipulé des outils et avoir raffiné ses connaissances en électricité, on a moins peur de faire des choses et on insiste sur l'aspect multidisciplinaire adapté à un niveau particulier. Un répondant note que sa connaissance du domaine s'est améliorée mais qu'il y a encore place à l'amélioration.

Un répondant dit que non et un autre ne répond pas à la question.

Question 5

Est-ce-que ces ateliers vous ont aidés à améliorer votre perception concernant l'importance de posséder une bonne culture technologique ?

Tous ceux qui répondent sont affirmatifs, un seul ne répond pas. On insiste surtout sur l'importance de bien préparer les élèves. On est enthousiasmé parce que les élèves aiment la pratique, parce que ça nous donne l'occasion d'utiliser de nouveaux outils donc d'être moins effrayés. On souligne qu'il faut une nouvelle vision de la technologie qui ne comprenne pas exclusivement l'ordinateur.

Question 6

Est-ce-que ces ateliers vous ont aidés à améliorer votre perception concernant l'importance d'intégrer la culture technologique à travers les matières académiques ?

À l'exception d'un seul répondant qui avait déjà une bonne perception du domaine, tous affirment que oui. On insiste notamment sur l'implantation possible du processus de résolution de problèmes dans toutes les matières et sur la perception nouvelle qui est nécessaire, en indiquant qu'il s'agit d'un défi. On demande des exemples touchant d'autres domaines que les sciences humaines, ou touchant les petits enfants. On parle de difficultés possibles si on ne connaît pas les programmes scolaires.

Question 7

Est-ce-que ces ateliers vous ont aidés à améliorer votre capacité d'intégrer la culture technologique à travers les matières académiques ?

La réponse à cette question est plutôt du type : oui, mais...

On note que, dans le quotidien, pour bien utiliser cette approche, on manque de temps, notamment pour les recherches, on manque de pratique, d'exemples et de méthode, particulièrement pour intégrer l'ensemble des matières. On souligne par ailleurs l'importance du processus de résolution de problèmes et de la pensée créative.

Question 8

Quelle a été votre impression générale des ces ateliers sur la culture technologique ?

Dans l'ensemble, tous les commentaires sont positifs. On souligne surtout la bonne préparation des ateliers (75 % des répondants), on mentionne qu'ils comprennent abondance de suggestions et de ressources, qu'ils sont intéressants, créatifs et motivants. On considère qu'ils sont bons pour les étudiants parce qu'ils développent l'esprit de groupe et permettent de communiquer. On apprécie le côté pratique des ateliers.

Dans un cas, même si on a apprécié les ateliers, on déplore qu'il y ait manqué des informations.

Question 9

Est-ce-que ces ateliers ont rencontré vos attentes?

Plus de la moitié des répondants affirment que l'atelier a rencontré leurs attentes, on est particulièrement heureux d'y avoir trouvé des idées pratiques. Un tiers des répondants déclarent qu'ils n'avaient pas d'attentes spéciales mais qu'ils ont bien apprécié l'atelier. Dans un cas, les attentes étaient biaisées par la mauvaise perception que l'on avait de la technologie et dans un autre cas, on dit que l'atelier répondait partiellement aux attentes en ce qu'il illustre un potentiel à développer mais on regrette de n'avoir pas fait une évaluation plus approfondie.

Question 10

Qu'avez-vous aimé le plus à propos de ces ateliers ?

La plupart des participants (83%) ont surtout apprécié le côté manipulation, l'aspect concret des ateliers, les activités pratiques. On note que ça nous aide à mieux comprendre pourquoi les élèves aiment ce genre d'activités et ça nous permet de mieux les intégrer dans l'enseignement. L'étude du processus technologique et des étapes dans la résolution de problèmes, de même que la nécessité d'imaginer des solutions différentes de celle des autres a également été apprécié. On souligne aussi l'abondance des ressources et l'ouverture que permettent ces ateliers, même à ceux qui ont une faible connaissance technique.

Question 11

Qu'avez-vous aimé le moins à propos de ces ateliers ?

La projection du film vidéo est questionnée par 25 % des répondants. On mentionne notamment que s'il est jugé essentiel, il devrait être projeté à la fin plutôt qu'au début. Un autre 25 % des répondants ne donne aucune réponse ou répond simplement "Rien".

Les autres réponses mentionnent le questionnaire d'évaluation, la théorie, le dessin des prototypes, le fait que l'atelier ne vise pas un seul niveau d'enseignement, le manque de continuité qu'implique une activité hebdomadaire et, finalement, le fait que l'on aurait aimé voir plus d'activités.

Question 12

Quels ont été les éléments les plus pertinents des ces ateliers?

L'étude du processus technologique est perçu comme l'élément le plus pertinent par la moitié des répondants, alors que la pratique d'activités technologiques est mentionnée par le quart d'entre eux. La motivation à agir ainsi, la méthodologie, les exemples et les ressources sont les autres points mentionnés.

Question 13

Quels ont été les éléments les moins pertinents des ces ateliers?

Dans une proportion de 83 %, les répondants au questionnaire ne mentionnent rien à ce point. On ajoute que les ateliers sont informatifs. Deux éléments sont perçus comme moins pertinents, soit le film vidéo et le fait que les ateliers ne s'adressent pas à un niveau d'enseignement unique.

Question 14

Que pensez-vous de la durée de ces ateliers ?

Pour 42 % des répondants, les ateliers n'étaient pas assez long. Par contre, 33 % des répondants jugent que la durée des ateliers était correcte. 25 % ont une position ambiguë en donnant des réponses du type "Ça passe très vite" ou "C'est assez pour nous donner le goût". Personne n'a jugé que les ateliers prenaient trop de temps.

Question 15

Que pensez-vous du contenu d'apprentissage de ces ateliers ?

Pour 75 % des répondants, le contenu d'apprentissage des ateliers était bien fait. On mentionne entre autres qu'il est pratique, qu'il explique bien les étapes et qu'il y a abondance de ressources.

Ceux qui ont quelques reproches à faire auraient aimé que l'on développe davantage certains points, que l'on explique un peu plus les documents fournis ou que l'on adapte l'atelier à un niveau d'enseignement précis.

Question 16

Pensez-vous qu'il y avait une bonne balance entre la théorie et la pratique ?

Tous les répondants considèrent qu'il y a un bon équilibre entre la théorie et la pratique, certains soulignant même que ceci les prépare mieux à le faire dans leurs propres cours. On mentionne aussi

que l'on préfère la pratique et que la théorie est présente dans les autres cours. Un seul répondant juge qu'il y a parfois un écart entre la théorie et la pratique.

Question 17

Que ferez-vous différemment comme enseignant(e) à la suite de votre participation à ces ateliers ?

Parmi les répondants, 58 % affirment qu'ils vont maintenant tenter d'intégrer la technologie (ou plusieurs technologies) à leur enseignement, parce que c'est motivant pour les élèves et que ça les stimule à communiquer en les amenant à formuler le fruit de leurs recherches. Pour 17 % des répondants, c'est l'aspect manipulation qui prime, ils vont donc viser à en inclure davantage. Un répondant déclare qu'il essaiera d'obtenir plus de matériaux pédagogiques.

Dans deux cas, on a mal compris la question et l'on suggère soit de ne rien changer aux ateliers, soit de les adapter à un niveau d'enseignement précis.

Un autre répondant déclare qu'il n'aura pas l'occasion d'enseigner.

Question 18

Comment pensez-vous mettre en application les connaissances ainsi que les habiletés acquises durant ces ateliers ?

Ceux qui ont répondu à la question entendent intégrer davantage les notions de technologie dans leur enseignement parce que c'est motivant pour les enfants de faire des manipulations et de voir les résultats concrets de leur démarche. On considère par ailleurs que c'est excellent pour développer le vocabulaire et la communication en général, bref pour enrichir l'apprentissage.

Un tiers des répondants n'ont rien indiqué à cette question alors qu'un du groupe a indiqué qu'il n'aurait pas l'occasion d'enseigner.

Question 19

Pensez-vous que tous les enseignants en formation initiale (les étudiants au niveau du B.Ed.) et que tous les enseignants de la maternelle à la 12e année devraient suivre des ateliers en culture technologique ? Justifiez votre réponse.

Tous les répondants sont d'avis que la formation des enseignants devrait comprendre des ateliers de culture technologique. La principale raison citée est que c'est important pour les élèves et qu'ils pourront ainsi mieux répondre à la demande dans le monde futur. On mentionne que si les

enseignants ne sont pas sensibilisés, les élèves n'apprendront pas. On note l'importance de la pensée créatrice, du processus de résolution de problèmes et de l'adaptation au progrès. On dit, finalement, que c'est motivant pour l'élève de participer à un apprentissage intégré.

Question 20

Avez-vous des suggestions pour améliorer ces ateliers à l'avenir ?

La moitié des répondants n'ont pas de suggestions ou considèrent que les ateliers sont très bien comme ça. Autrement, on suggère d'accorder plus de temps pour les croquis, de centrer l'atelier sur des activités à faire avec de très jeunes enfants, d'insister sur la pratique et sur les applications de la technologie, de préparer un atelier sur l'utilisation de l'ordinateur, de donner plus d'idées, d'exemples d'activités, de tenir l'atelier dans une plus grande salle de classe et, finalement, d'instaurer un cours à l'université portant sur ce sujet.

Question 21

Que pensez-vous du matériel didactique distribué au cours de ces ateliers ?

Les participants qui ont répondu au questionnaire ont trouvé, de façon générale, que le matériel didactique était abondant et rempli de beaucoup d'idées. On le trouve bien organisé, intéressant, pertinent, facile à suivre, mais surtout informatif. Un seul répondant considère qu'il y en avait peut-être trop, mais il mentionne qu'il y a retrouvé les informations qu'il cherchait.

Question 22

Que pensez-vous du matériel de support qui a été mis à votre disposition à la bibliothèque de la faculté d'éducation ?

Parmi les répondants qui ont eu l'occasion de consulter la documentation, on mentionne qu'elle est abondante, bien à propos, qu'elle offre une belle variété en ce qui concerne les idées de projets et les niveaux d'étude visés. On apprécie cette source de référence. On note toutefois qu'il serait bon d'avoir un sommaire descriptif de chacun des documents.

Un tiers des répondants n'avait pas eu l'occasion de consulter la documentation.

Question 23

Autres commentaires :

Près de 60 % des répondants ne font aucun commentaire.

On mentionne que, dans les groupes de très jeunes enfants, il pourrait y surgir un problème puisque chaque enfant voudra garder le fruit du travail d'équipe.

On suggère, par ailleurs, de tenir ces ateliers plus tôt dans l'année, de façon à mettre à profit le plus tôt possible ces nouvelles techniques.

On aimerait voir présenter plusieurs programmes ou logiciels d'ordinateurs.

Certains répondants adressent des remerciements aux animateurs, en soulignant l'aspect positif de cette formation. On répète que c'est important pour les élèves qui vont évoluer dans un monde où la technologie sera omniprésente.